KANSAS GEOLOGICAL SURVEY
The University of Kansas

# SURFICIAL GEOLOGY OF CRAWFORD COUNTY, KANSAS

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## 2008

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# MAP M-120

### GENERAL GEOLOGY

Crawford County, in southeastern Kansas, is bounded on the north by Bourbon County, on the south by Cherokee County, on the west by Neosho and Labette counties, and on the east by the state of Missouri. The county has a total area of 595 mi² (1,541 km²), of which 593 mi² (1,536 km²) is land and 2 mi² (6 km²; 0.36%) is water. Pennsylvanian sedimentary rocks – limestones, mudrocks, sandstones, and coals – crop out within the county and range in age from the lower Desmoinesian (Cherokee Group) to the lower Missourian (Kansas City Group). The general orientation of these rocks is diagonally (northeast-southwest) across the county from the oldest (Cherokee Group), exposed in the southeastern corner of the county, to rocks of the Marmaton and Pleasanton Groups across the middle, to the youngest (Kansas City Group) rocks in the northwestern corner. Although the boundary between the Desmoinesian and Missourian stages occurs within the county, it is not recognizable lithostratigraphically.

Rocks of the Cherokee Group are mostly siliciclastics (mudrocks and sandstones), with an occasional thin limestone. It is within this interval that most of the economically important coal beds occur. The lower Marmaton Group consists of siliciclastics and thick limestones; the upper Marmaton and Pleasanton Groups are mostly siliciclastics with thin limestones; and the Kansas City Group consists of mudrocks and thick limestones.

### GEOMORPHOLOGY

Physiographically, Crawford County can be roughly divided diagonally along a line from near the northeast corner of the county to the southwest corner. The Osage Cuestas characterize the area northwest of this line and the Cherokee Lowlands the area to the southeast. Rocks found in the Osage Cuestas are composed of alternating layers of sandstone, limestone, and mudrock. The cuestas, with steep east-facing slopes and flatter west-dipping flanks, are less well developed here than in other parts of this physiographic province. Smooth, grassy, gently sloping topography and areas of long, narrow, water-filled pits and heavily vegetated hummocks – both the result of extensive strip mining for coal – now characterize much of the Cherokee Lowlands in Crawford County. The grassy, gently sloping areas are the results of reclamation that was required of mining companies after 1969. Prior to 1969, reclamation was not required and the pits and hummocky areas are the result. These mined areas are now private property and homesites, and public hunting, fishing, and wildlife areas.

Topographic relief in the county is 360 ft (110 m) with the highest area (1,150 ft, 350 m) in the northwestern corner and the lowest (790 ft, 240 m) in the northeastern corner. This relatively low topographic relief is attributed to the abundance of siliciclastic bedrock that easily weathers. No major rivers are present in the county, but several creeks, including Hickory, Lightning, and Walnut, drain to the southwest; Cow Creek drains to the southeast; and Bone and Cox creeks, and the West Fork of Dry Wood Creek, drain to the northeast. Two lakes are located in the northeastern part of the county. A dam on the West Fork of Dry Wood Creek created Farlington Lake, and Bone Creek Reservoir is on Bone Creek.

### STRUCTURAL GEOLOGY

The general direction of strike in Crawford County is northeast-southwest with regional dip to the northwest at 15–20 ft per mile. Locally, strike and dip directions can vary significantly. A possible fault was mapped in the Grindstone Creek quadrangle based on Pierce and Courtier (1937) and supported with outcrop data. Another possible fault, found in the McCune quadrangle, is a projection of a fault mapped by Bennison (2002) in Cherokee County.

### MINERAL RESOURCES

Crawford County is known for its coal-mining heritage and many different ethnic groups settled here to work in the coal fields. Other industries supported by mineral resources include brick and tile plants and zinc smelters. Mudrocks provide the raw material for brick, tile, and other ceramic products. Coal for fuel attracted the zinc smelters – the ore came from Cherokee County and Missouri.

### Explanation

**Boundaries and Locations**

- State line
- County line
- Township/range line
- Section line
- Y County seat
- City
- H Locality
- ▨ Built-up area

**Transportation**

- U.S. highway
- State highway
- Medium-duty primary road
- Medium-duty secondary road
- Light-duty road
- Unimproved road
- Railroad
- Landing field
- Airport

**Geologic Unit Boundaries**

- Geologic contact

**Hydrology and Topography**

- Perennial stream
- Water body
- 300 Elevation contour (50-meter interval)
- Elevation contour (10-meter interval)

**Geologic Structure**

- U D ? Fault, existence questionable, location inferred. U, upthrown block; D, downthrown block

**Resource Development**

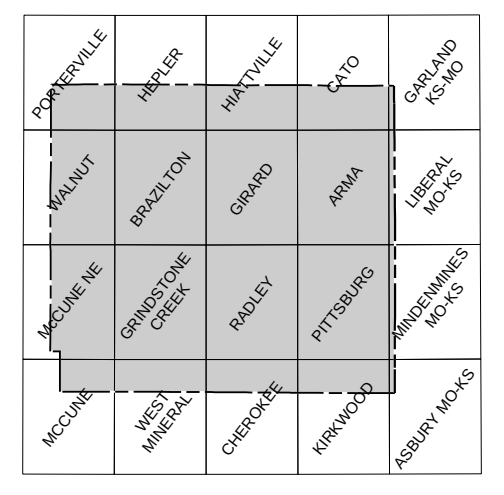
- Quarry
- Abandoned quarry

**Mines, Pits, and Quarries**

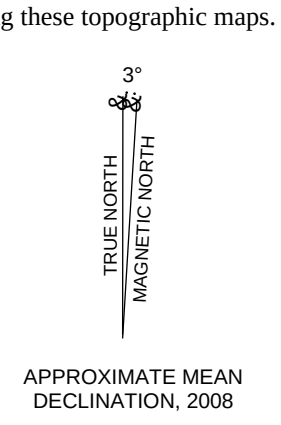
Coal mines

- Ptc Strip pit
- ucm Underground coal mine (Abernathy, 1944)
- Ptcl Clay pit
- Ptls Limestone quarry

### Index to 1:24,000-scale USGS quadrangle maps



Index shows the names and locations of the 24 USGS 7.5-min 1:24,000-scale quadrangles used in the digital compilation of the Crawford County map. The geology was mapped in the field using these topographic maps.



APPROXIMATE MEAN DECLINATION, 2008

Elevation contours are presented for general reference. They are taken from USGS Digital Line Graph (DLG) files compiled from base maps at a scale of 1:100,000. In some places the contours from the DLGs may be more generalized than the base maps used for compilation of geologic outcrop patterns. Outcrop patterns on the map will typically reflect topographic variation more accurately than the associated contour lines. Repeated fluctuation of an outcrop line across a contour line should be interpreted as an indication that the mapped rock unit is maintaining a relatively constant elevation along a generalized contour.

Roads and highways shown on the base map as represented by data from the Kansas Department of Transportation (KDOT) and other sources. U.S. Department of Agriculture – Farm Services Agency (USDA-FSA) National Agriculture Imagery Program (NAIP) imagery also was used to check road locations.

Shaded relief is based on a USGS digital elevation model (DEM) with 1/3 arc-second resolution. The 1/3 arc-second data, in ESRI GRID format, were converted to a hillshade, a multidirectional shaded-relief image using angles of illumination from 0°, 225°, 270°, and 315° azimuths, each 45° above the horizon, with a 4x vertical exaggeration.

Map partially funded by the National Cooperative Geologic Mapping STATEMAP program.

This map was produced using the ArcGIS system developed by ESRI (Environmental Systems Research Institute, Inc.).

The Kansas Geological Survey does not guarantee this map to be free from errors or inaccuracies and disclaims any responsibility or liability for interpretations made from the map or decisions based thereon.

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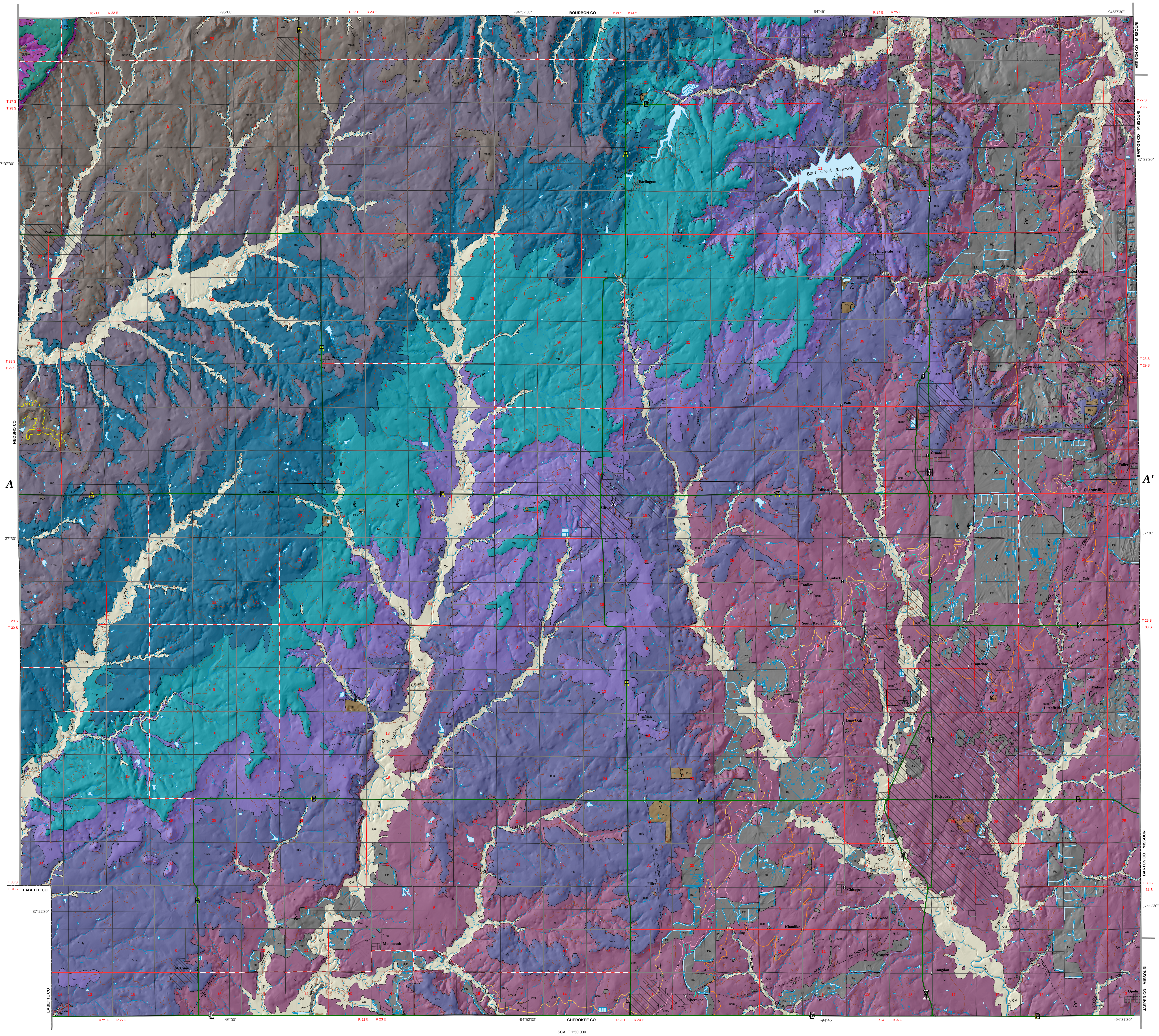
### Suggested reference to this map

West, R. R., Sawin, R. S., and Brady, L. L., 2008, Surficial geology of Crawford County, Kansas: Kansas Geological Survey, Map M-120, scale 1:50 000.

### Supplemental reference

West, R. R., and Sawin, R. S., 2008, Data control points used to construct the surficial geology map (M-120) of Crawford County, Kansas: Kansas Geological Survey, Open-file Report 2008-19, 76 p.

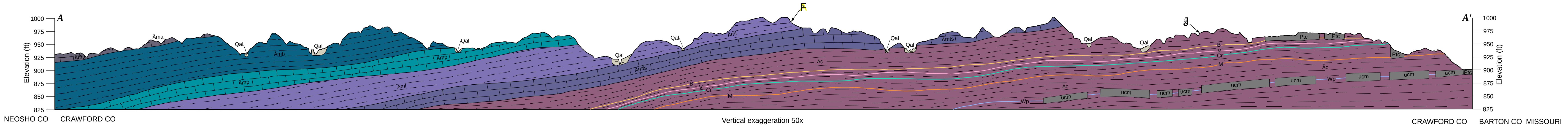


SCALE 1:50 000

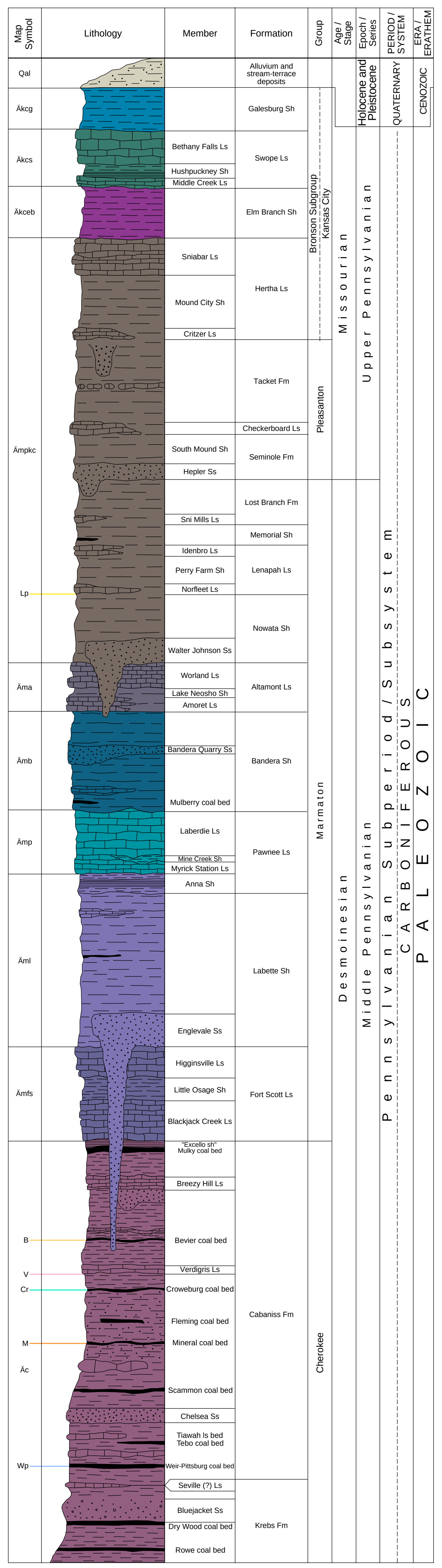
1 0.5 0 1 2 3 4 MILES

1 0.5 0 1 2 3 4 5 KILOMETERS

LAMBERT CONFORMAL CONIC PROJECTION
WITH STANDARD PARALLELS AT 33° AND 45°
NORTH AMERICAN DATUM OF 1927



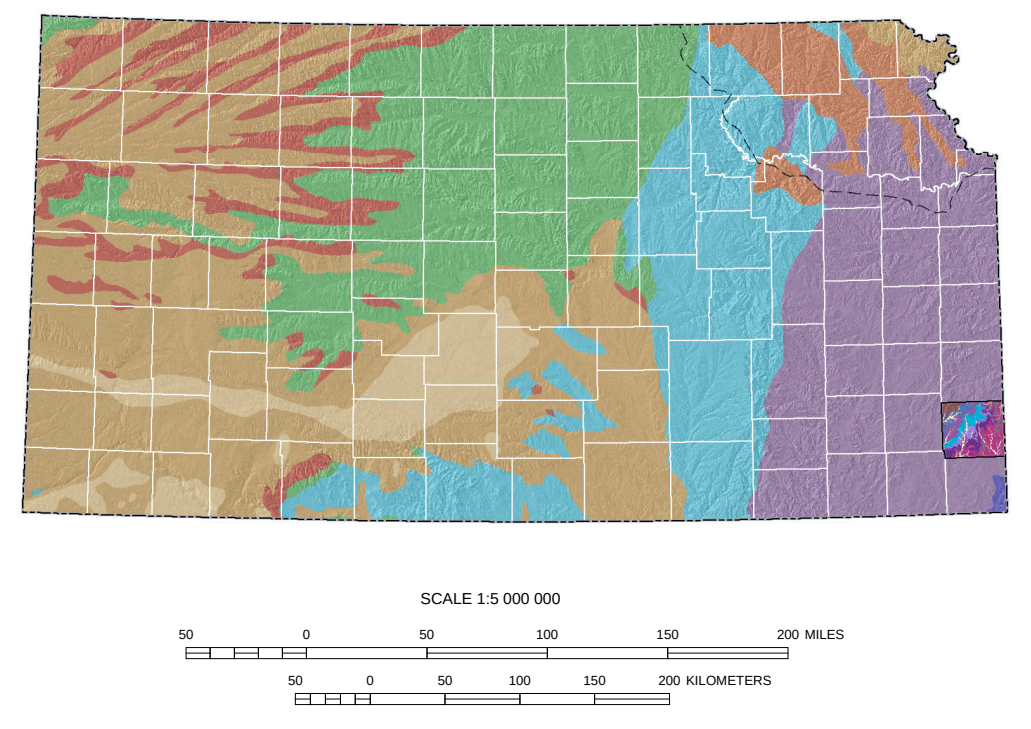
Vertical exaggeration 50x



**Lithologic Explanation**

| | | | |
|---|---|---|---|
| | Unconsolidated silt, sand, and gravel | | Sandstone |
| | Limestone | | Sandy mudrock |
| | Black shale | | Mudrock |
| | | | Coal |

### LOCATION DIAGRAM



**GENERALIZED GEOLOGY OF KANSAS**

| QUATERNARY SYSTEM | NEOGENE SYSTEM | CARBONIFEROUS SYSTEM |
|---|---|---|
| Holocene - Pleistocene Series | Pliocene - Miocene Series | |
| Loess and river-valley deposits | Ogallala Fm | Pennsylvanian Subsystem |
| Sand dunes | CRETACEOUS SYSTEM | Mississippian Subsystem |
| Glacial-drift deposits | PERMIAN SYSTEM | |
| Limit of glaciation in Kansas | | |

Computer compilation and cartography by the Kansas Geological Survey's Cartographic Services unit. For purchase information, or for information about other KGS maps or publications, please call

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### CENOZOIC

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**Alluvium and stream terraces** – Alluvial and stream-terrace deposits include sand, gravel, silt, and clay that were deposited on floodplains by streams, creeks, and rivers. Deposits 5 ft or more in thickness are included in this unit, based on Rott et al. (1973).

### PALEOZOIC

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**Galesburg Shale** - The Galesburg Shale, a medium- to dark-gray to yellowish-brown, platy to blocky mudrock that may be silty and/or sandy, is commonly covered. It ranges from 2 to 15 ft in thickness and occurs only in the extreme northwestern part of the county.

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**Swope Limestone** - At the base of the Swope Limestone, the Middle Creek Limestone Member is a hard, dense, gray, sparsely fossiliferous limestone between 1 and 2 ft thick. It is easily identified because of its position just below the dark-gray to black, platy to fissile shale of the Hushpuckney Shale Member. The lower part of the Hushpuckney is black shale and the upper part is a yellowish-gray mudrock. The average thickness of the Hushpuckney is about 3 ft (Jungmann, 1966). Overlying the Hushpuckney shale is the Bethany Falls Limestone Member, consisting of 12 to 15 ft of thin, wavy-bedded, light-gray, fossiliferous limestone. The upper 10 to 12 ft of the Bethany Falls is more thickly bedded and is whitish gray with darker-gray mottling. Oolitic beds may also be present. The Swope Limestone is exposed only in the northwestern corner of the county.

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**Elm Branch Shale** - The Elm Branch Shale ranges from 5 to 15 ft in thickness. Most often this unit is covered, but when exposed, is a medium- to dark-gray to yellowish-brown, platy to blocky mudrock. Locally, it may be slightly silty and sandy. Formerly the Ladore Shale (Zeller, 1968), the name Elm Branch Shale was proposed by Heckel and Watney (2002).

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**Hertha Limestone, Tacket Formation, Checkerboard Limestone, Seminole Formation, Lost Branch Formation, Memorial Shale, Lenapah Limestone, and Nowata Shale** - The interval between the base of the Sniabar Limestone Member of the Hertha Limestone and the top of the Altamont Limestone is predominately siliciclastic with several thin, discontinuous limestones. The combined thickness of these units ranges from 100 to over 180 ft. The Desmoinesian and Missourian boundary occurs within this interval, but lithostratigraphic evidence for separating them was not found.

*Hertha Limestone* - The Hertha Limestone is composed of three members that are, in ascending order, the Critzer Limestone Member, the Mound City Shale Member, and the Sniabar Limestone Member. The Critzer limestone is probably absent in Crawford County, and the Mound City shale is often indistinguishable from the underlying Tacket Formation. The Sniabar Limestone Member is a gray, medium- to thick-bedded, fossiliferous limestone that ranges from 5 to 10 ft thick. The Sniabar is commonly an algal limestone with numerous vugs. Abundant iron oxide gives it a dark-reddish-brown color on weathered surfaces.

*Tacket Formation* - The Tacket Formation is a gray, blocky, argillaceous mudrock that contains a thin, nodular limestone in the middle; the thickness in Crawford County is estimated to be about 60 ft (Emery, 1962; Jewett et al., 1965). Because the Checkerboard Limestone is thin or absent, it is difficult to separate the Tacket from the underlying Seminole Formation.

*Checkerboard Limestone* - The Checkerboard Limestone (or its equivalent) may be locally present (a thin limestone in the Hepler quadrangle was tentatively identified as the Checkerboard Limestone); however, it is commonly absent (Jewett et al., 1965).

*Seminole Formation* - The Seminole Formation contains two members, the Hepler Sandstone Member and the South Mound Shale Member. The Hepler sandstone is a relatively thin, fine-grained, brown to gray sandstone that may be calcareous; it is sometimes seen in outcrop. The South Mound shale is a gray, argillaceous mudrock and may contain minor amounts of coal and limestone (Jewett et al., 1965); it is usually covered in Crawford County. The Seminole Formation is about 15 to 20 ft thick (Jewett et al., 1965).

*Lost Branch Formation and Memorial Shale* - The Lost Branch Formation and Memorial Shale (in descending order) are not well exposed in Crawford County. Jewett (1945) suggested the combined thickness of these gray, bedded, slightly blocky clay mudrock units is generally less than 30 ft. Formerly the Holdenville Shale (Zeller, 1968), Heckel (1991) proposed the names Lost Branch Formation and Memorial Shale.

*Lenapah Limestone* - The Lenapah Limestone consists of two limestones and an intervening mudrock. They are, in ascending order, the Norfleet Limestone Member, Perry Farm Shale Member, and Idenbro Limestone Member. The Norfleet limestone is probably thin bedded and poorly developed (less than 1 ft) or absent in Crawford County (Jewett, 1945). The Perry Farm shale is a gray mudrock that may contain thin beds of limestone or irregular limestone nodules. The thickness may range from 10 to 15 ft (Jewett, 1945). The Idenbro limestone is a light-gray and massive to irregularly bedded limestone. It is probably thin (about 3 ft) (Jewett, 1945) and inconspicuous in most of Crawford County.

*Nowata Shale* - The poorly exposed Nowata Shale is composed of light-gray, yellow, limonitic mudrocks, sandy mudrocks, and sandstone, and varies in thickness from a few feet to nearly 50 ft (Jewett, 1945). An incised-valley-fill sandstone, the Walter Johnson Sandstone Member, occurs in the lower part of the Nowata, but may be locally absent. In northern Bourbon County, the Walter Johnson cuts out part, or all, of the Altamont Limestone. The Walter Johnson sandstone was not observed in Crawford County.

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**Altamont Limestone** - In ascending order, the Altamont Limestone is composed of the Amoret Limestone Member, the Lake Neosho Shale Member, and the Worland Limestone Member. The Altamont limestone ranges from a few feet to nearly 20 ft in thickness, but in general, is not well exposed in Crawford County. The best exposures are in the Walnut Creek drainage. The Amoret Limestone is a thin-bedded to platy, hard, grayish-brown, fossiliferous limestone that is sometimes crossbedded and may contain mudrock layers; it may be up to 10 ft thick. The Lake Neosho shale is a yellow-brown to light-gray to black mudrock; the black mudrock (shale) contains dark phosphatic nodules. This member is characteristically about 2 ft thick but can range up to 6 ft (Jewett, 1945). The Worland limestone is a thin- to massive-bedded, light-gray, hard, dense limestone that is about 8 to 10 ft thick.

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**Bandera Shale** - The Bandera Shale is up to 95 ft thick in Crawford County, but is more typically 40 to 60 ft thick (Jewett, 1941, 1945; Jungmann, 1966) and is a massive to thin-bedded, reddish-brown sandstone; thin-bedded to platy, light-gray to brownish, silty mudrocks; and clayey siltstones. The Mulberry coal, which occurs near the base of the Bandera, was reported in highway borings near the intersection of Kansas Highways 3 and 57 (Kansas Dept. of Transportation, Geological Plan and Profile, Kansas Highway 57, Crawford County, KS).

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**Pawnee Limestone** - Units mapped as the Pawnee Limestone are, in ascending order, the Myrick Station Limestone Member, Mine Creek Shale Member, and Laberdie Limestone Member. The combined thickness of these three members ranges from 10 to 30 ft. Although the Anna Shale Member is formally recognized (Zeller, 1968) as the basal member of the Pawnee Limestone, this study does not support the mappability of the base of the Anna shale. Because the thickness of the Anna is variable (generally 2 to 6 ft) and the top of the Labette is often a black to very dark gray mudrock, it is difficult to distinguish it from the overlying Anna. The Myrick Station limestone is a thin-bedded, gray, fossiliferous limestone that weathers into reddish-orange-brown blocks. The thickness of the Myrick Station ranges from less than a foot to over 8 ft. The Mine Creek shale, a dark-gray, fossiliferous, mudrock, is thin (usually less than 2 ft) and sometimes absent (Jewett, 1945). The Laberdie limestone, a hard, dense, wavy-bedded light-greenish-gray limestone of variable thickness up to nearly 20 ft, is responsible for most of the thickness of the Pawnee Limestone.

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**Labette Shale** - The Labette Shale is a siliciclastic unit that contains clay and silt mudrocks, sandstone, and minor amounts of limestone and coal. The thickness ranges from 30 to over 70 ft. The Englevale Sandstone Member, a reddish-brown, micaceous, massive, crossbedded sandstone, occurs in the lower part of the Labette and appears to be an incised-valley-fill deposit. Formerly referred to as a channel sandstone, in places it cuts out the lower Labette Shale, the Fort Scott Limestone, and the Cabaniss Formation down to the top of the Verdigris Limestone Member (Howard and Schoewe, 1965). The Englevale sandstone valley fill is most obvious between the towns of Arma and Englevale. Poorly developed, thin (less than 1 ft) coals can occur within the Labette.

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**Fort Scott Limestone** - The Fort Scott Limestone consists of two prominent limestone members and a dark-gray to black intervening mudrock. The Fort Scott Limestone is stratigraphically the lowest significant limestone in the county and ranges from 15 to over 35 ft in thickness. The lowest member, the Blackjack Creek Limestone Member, is thinly bedded in the upper part with the lower part more medium to thickly bedded. It is 10 to 20 ft of hard, dense, gray to brown, fossiliferous (chaetetids) limestone. Between the two limestone members is the Little Osage Shale Member, a 5- to 6-ft-thick, dark-gray to yellowish-brown mudrock in the upper part and black, platy to fissile shale in the lower part. The uppermost Higginsville Limestone Member is a light- to medium-dark-gray, dense, thin to irregular, wavy-bedded, fossiliferous, sometimes brecciated limestone that is about 15 to 20 ft thick.

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**CHEROKEE GROUP** - The Cherokee Group, a siliciclastic sequence, consists of marine and nonmarine sandstones, thin limestones, coal beds, and sandy mudrocks. The Cherokee Group (including surface and subsurface rocks) in Crawford County is up to 400 ft thick (Brady et al., 1994; Ebanks et al., 1977). The Cabaniss Formation above and the Krebs Formation below are separated by the Seville (?) Limestone Member (Zeller, 1968). The Seville (?) limestone was not observed during this study.

*Cabaniss Formation* - Underlying the Blackjack Creek limestone is the informally named Excello shale, a black, fissile to platy shale that overlies the Mulky coal bed. Beneath the Mulky coal is the Breezy Hill Limestone Member, a thin-bedded, often pedogenic limestone. The Breezy Hill averages less than 2 ft, but can range from a feather-edge to 8 ft (Schoewe, 1959). The Bevier coal bed is below the Breezy Hill limestone.

The Verdigris Limestone Member is up to 3 ft thick and is easily recognized where it is exposed; however, exposures are rare. Between the Verdigris limestone and the Chelsea Sandstone Member, in descending order are the Croweburg, Fleming, Mineral, and Scammon coal beds. The Fleming and Scammon coals are poorly developed in Crawford County. The Chelsea sandstone is about 30 ft of gray to brown, fine-grained, micaceous sandstone, which is locally conglomeratic (Howe, 1956). Below the Chelsea sandstone is the poorly developed Tiawah limestone bed, the Tebo coal bed, and the Weir-Pittsburg coal bed, the lowest coal in the Cabaniss Formation.

Four coal beds - the Bevier, Croweburg, Mineral, and Weir-Pittsburg - were mapped using data in the files of the Kansas Geological Survey.

*Krebs Formation* - The Bluejacket Sandstone Member, Dry Wood coal bed, and Rowe coal bed, in descending order, comprise the upper Krebs Formation in Crawford County. The reddish-brown Bluejacket sandstone is predominantly angular to subangular quartz with a conglomerate often at the base (Zeller, 1968) and is over 10 ft thick. Both coal beds are thin and appear to be discontinuous.

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